# Water Quality in Ontario Report 08 Highlights

*Protecting our environment.*

Ontario

PIBS 6920e



Cette publication est disponible en français sous le titre *Rapport de 2008 sur la qualité de l’eau en Ontario : points clés.*

This *Highlights* report summarizes the information in the *Water Quality in Ontario 2008 Report*.

For more information on this report please contact the Ontario Ministry of the Environment at water.monitoring@ontario.ca.

You can also contact the ministry’s Public Information Centre at 1-800-565-4923 or picemail.moe@ontario.ca

To download copies of this report and the full *Water Quality in Ontario 2008 Report* please visit the ministry’s website, www.ontario.ca/environment.

# Introduction

Clean water is essential. We are very lucky in Ontario. Our province borders on four of the five Great Lakes and we have more than a quarter of a million lakes, rivers and streams. These water resources are the cornerstone of the quality of life that we enjoy in Ontario. Our health, the health of the environment and our economic prosperity depend on them. This is why the Ontario government is working hard to make our water among the best protected in the world.

Taking action to protect the Great Lakes and Lake Simcoe, reducing toxics and combating climate change are amongst the Ontario government's top environmental priorities. In the *Water Quality in Ontario 2008 Report* we present information from the Ontario Ministry of the Environment's water monitoring programs. We focus on phosphorus enrichment, acid rain, toxic substances and climate change since information on these issues is important to addressing the priorities. With the exception of the emerging issue of climate change, the ministry has been monitoring these issues for decades.

# Water Quality Monitoring

## Why is water quality monitoring necessary?

- Water quality monitoring provides information on the quality of water resources in Ontario. We need this information to understand the state of the environment, the impacts of our activities and the progress that is being made to protect water resources.
- Monitoring helps with prioritizing the issues to be addressed and choosing the geographic areas in which to concentrate, helping to ensure effective management of water resources.
- Monitoring provides a direct measure of success to determine if investments and efforts by governments, industry and individuals are working to protect water quality in Ontario.
- Monitoring supports the early identification of new and emerging environmental problems. This information is necessary to develop policies and regulations to protect our water resources.

The ministry works closely with Ontario's Conservation Authorities to monitor water quality in rivers and streams.

## Ministry of the Environment Responsibility for Water Quality Monitoring

The ministry's Environmental Monitoring and Reporting Branch leads the operation of provincial-scale programs to monitor surface and groundwater quality across Ontario. The ministry's water monitoring activities are integrated with the sample analysis done at the Laboratory Services Branch. From basic water quality parameters such as pH and turbidity to metals such as mercury and lead, organic compounds including PCBs and pesticides,

Partners participate in training workshops to learn the protocols for collecting and identifying benthic invertebrates.

The ministry's **monitoring** programs include the **chemical analysis of water, sediment and tissue** and the **biological analysis of aquatic communities.**

and microbiological organisms, the ministry's laboratory analyzes tens of thousands of water samples each year for hundreds of possible pollutants.

The ministry collects and analyzes samples of water, sediment and aquatic life. The types of samples that are collected, and the ways in which the samples are analyzed, vary with the objectives of the monitoring. The ministry's monitoring programs include the chemical analysis of water, sediment and tissue and the biological analysis of aquatic communities. Additional innovative sampling strategies are also used in situations where conventional approaches are insufficient.

The success of the ministry's monitoring programs depends largely on the contributions of partners and volunteers. The ministry works closely with government partners such as the Ontario Ministry of Natural Resources, Environment Canada, municipalities and Conservation Authorities. Other partners are dedicated volunteers from the public and environmental organizations such as lake associations.

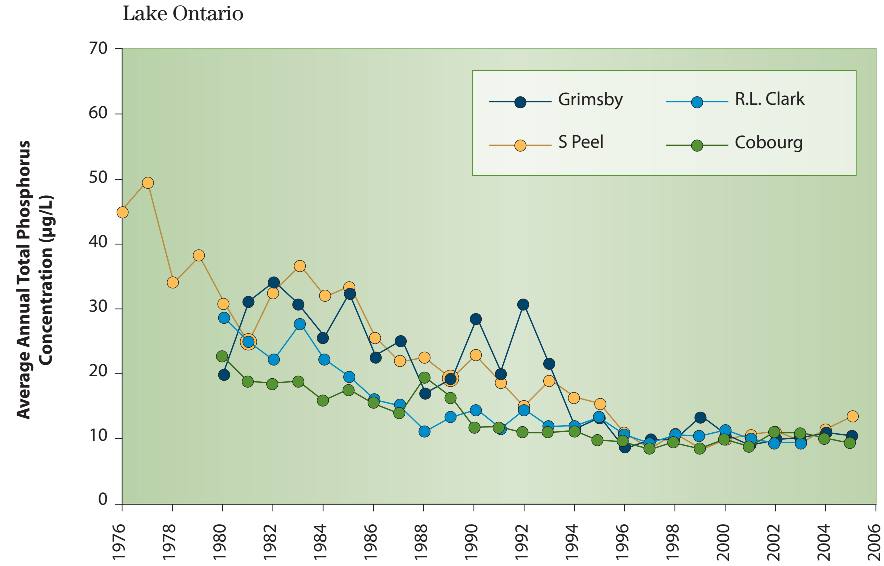
Benthic invertebrates, such as the mayfly nymph (about 1 cm long), are good indicators of water quality.

# Phosphorus Management

Phosphorus is an essential nutrient for plant and animal growth. Phosphorus enters water from natural processes and human activities. Excessive inputs of phosphorus can disrupt natural processes and harm aquatic habitats. High concentrations of phosphorus can stimulate the excessive growth of algae resulting in a *bloom*. Algal blooms can reduce the clarity of water and make the water taste and smell unpleasant. Certain species of algae can produce toxins, which can harm animals and humans. Algae can also form mats on the water surface or clumps on the bottom of lakes, which can foul beaches.

Excessive plant and algae growth in a water body can also cause large fluctuations in dissolved oxygen concentrations. Some species, such as trout, need consistently high levels of oxygen to survive and reproduce.

Phosphorus reduction programs were initiated in the 1970s. Significant decreases in the annual average total phosphorus concentrations have been recorded since the 1980s in the Great Lakes, inland lakes, and rivers and streams. Reductions in the use of phosphates in laundry detergents, improved sewage treatment, and the implementation of agricultural best management practices contributed to this decline.




Annual average phosphorus concentrations have decreased at the intakes of municipal water treatment plants that draw water from Lake Ontario.

Phosphorus concentrations have also declined in lakes in undeveloped watersheds on the Canadian Shield, possibly due to acid deposition and climate change. This is one of many examples where multiple stressors are interacting to influence water quality.

The lowest phosphorus concentrations are typically found in lakes and streams in central and northern Ontario; the highest are found in southern Ontario, where the landscape has been developed for agricultural and urban land uses.

## Protecting Lake Simcoe

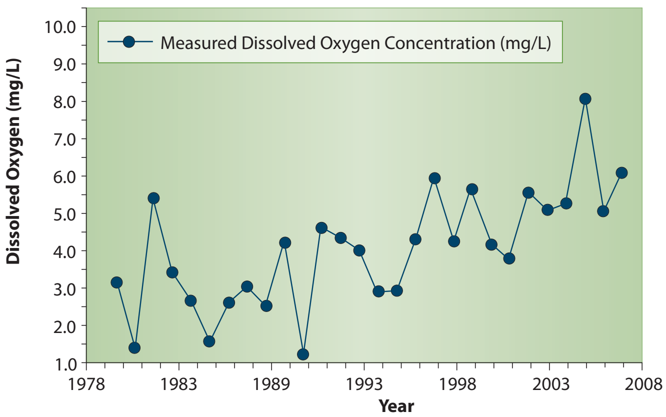
Governments and other stakeholders have been working to reduce phosphorus inputs to Lake Simcoe, the largest inland lake in southern Ontario and a valuable natural resource known for its excellent fishery. Monitoring results show that phosphorus inputs to the lake from tributaries have decreased significantly and that oxygen levels at the bottom of the lake have increased; however, phosphorus inputs need to be reduced further as part of a broad strategy to restore and protect the lake.

## Great Lakes Shoreline Fouling

Successful efforts to reduce phospho-

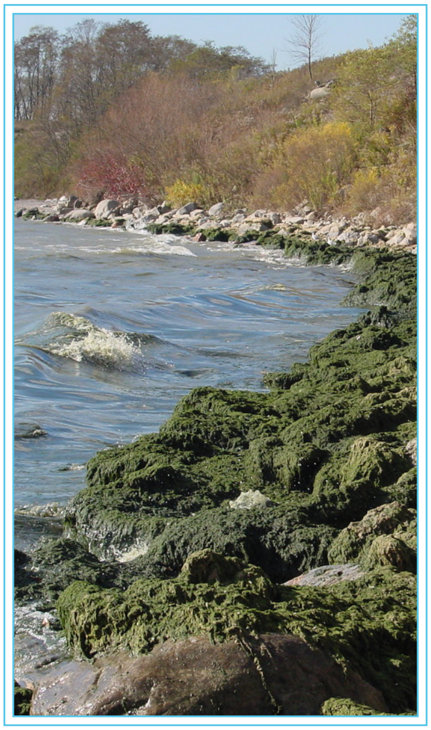
rus loads to the Great Lakes in the 1970s alleviated lakeshore fouling by the green alga *Cladophora*. Recently, *Cladophora* problems have returned. It is possible that phosphorus levels are increasing locally along some areas of shoreline, and contributing to the enhanced growth of algae. Phosphorus levels in many tributaries to the Great Lakes remain sufficient to cause nuisance plant growth and algal blooms. The invasive zebra and quagga mussels could also be a factor. Zebra mussels feed by filtering plankton and other particles from the water. The filtering action of mussels can thus clarify the water, resulting in more light penetration, which allows plants like *Cladophora* to grow at greater depths in a lake. Mussels might also be enhancing *Cladophora* growth by retaining phosphorus in the nearshore (shallow areas near the shoreline) of the Great Lakes.

The ministry has developed innovative approaches to monitoring water quality along the nearshore. These approaches are helping us to understand the influence of phosphorus inputs from tributaries and the impacts of invasive mussels.




Levels of dissolved oxygen in the deep waters of Lake Simcoe in late summer have increased (minimum volume-weighted, 18m to bottom concentrations from 15 June to 15 September).

Lawns of *Cladophora* growing on the lakebed of Lake Ontario in 2003.



Masses of *Cladophora* on the shoreline of Lake Ontario in 2007.

# Progress on Acid Rain

Acid rain is rain that has become more acidic than normal by mixing with pollutants in the atmosphere. A more precise term is *acid deposition* which includes wet deposition (rain, snow and fog) and dry deposition (dust particles and gases).

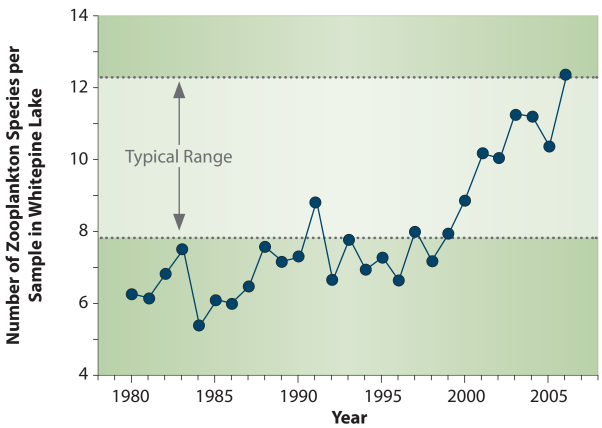
The acidification of a water body can result in dramatic changes to the types of plants and animals that live there because many of them cannot reproduce or survive in an acidified environment. The number of different kinds of plankton and fish decreases as water bodies become more acidic. Some lakes may become too acidic to support fish at all. Acid deposition also has other effects on water quality. As acid precipitation moves through the watershed, metals contained in the soil can be released into streams and lakes, which may have toxic effects on aquatic species.

The Ontario government has been working cooperatively with industries and other governments, including State governments since the 1970s to reduce emissions of air pollutants that cause acid deposition. This has led to the recovery of some lakes in central and northern Ontario. The greatest improvements have occurred in the Sudbury region, where acid-causing emissions from metal smelters have declined by 90% in the last 40 years.

## Recovery of Lakes in the Sudbury Region

Reduced smelter emissions have resulted in changes in the water quality of lakes in the Sudbury region. Biological recovery has been observed in some lakes among various groups of organisms including fish, phytoplankton, benthic invertebrates and zooplankton. Some lakes have improved to the point that successful re-introductions of sport fish have been possible.

While some Sudbury area lakes have shown improvement, many lakes are still severely acidified, and recovery is still at an early stage and continuing. It has become clear that the chemical and biological recovery of Sudbury area lakes from acidification is closely linked to the effects of other major environmental stressors such as climate change. Future studies of the recovery of acid-damaged lakes will need to be conducted in the context of multiple interacting stressors. Ongoing monitoring has demonstrated that efforts by industry to reduce pollution are effective, and that regulatory mechanisms to encourage and enforce these measures are justified.



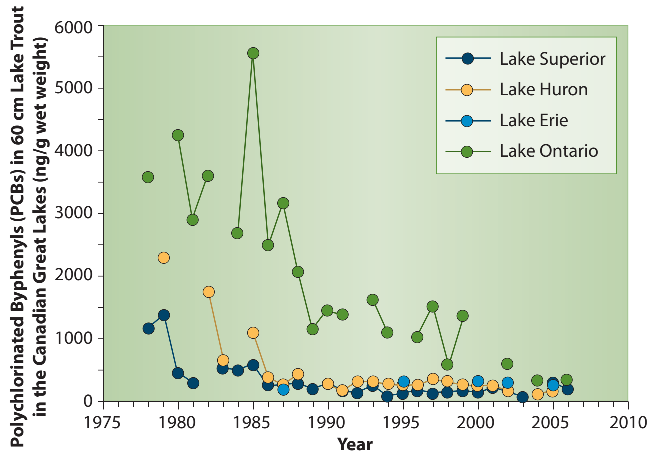

Whitepine Lake, located near Sudbury in the area impacted by sulphur deposition, is showing signs of recovery. The number of zooplankton species in the lake is increasing as water quality improves. The dashed lines represent the typical range in number of zooplankton species in 22 non-acidic reference lakes.

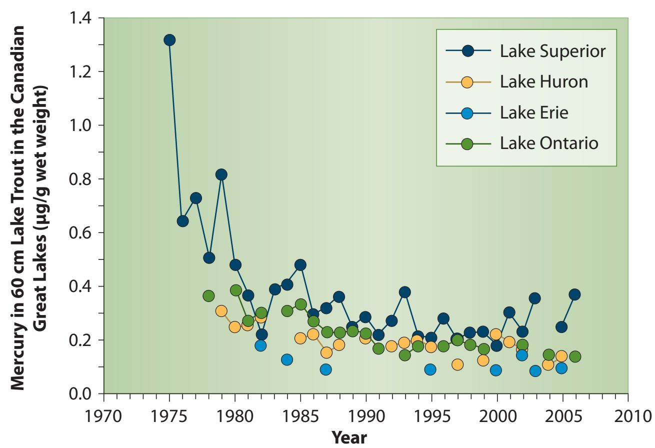
# Reducing Toxic Substances

Persistent, bioaccumulative and toxic substances (PBTs) are long-lasting chemicals that can build up in fish, wildlife, and humans. These substances do not break down easily, and are difficult and expensive to clean up once they are released to the environment. They can impact animal and human health, including increased risks of cancer and effects on the nervous and reproductive systems. Some PBT substances can be carried long distances through the air, and enter the aquatic environment through precipitation and other processes. This can cause some contamination in even the most remote lakes and streams.

Many PBTs are human-made; others, such as mercury and fluoride, occur naturally in the environment.

Government regulations to ban some chemicals and limit the amounts of chemicals that can be released in industrial discharges have dramatically reduced the amounts of these substances in the environment. Long-term monitoring has shown that levels of PBT substances, particularly PCBs (polychlorinated biphenyls) and mercury, are generally decreasing in sport fish from the Canadian Great Lakes and Ontario's inland lakes. However, sport fish consumption advisories are still required for many lakes and streams in Ontario due to ongoing contamination by toxic substances.




Concentrations of PCBs and mercury have decreased over time in lake trout from the Canadian Great Lakes, but lower levels of contamination remain.

Some new chemicals used in consumer and building products have been found in increasing concentrations in the environment. An example is flame retardants or PBDEs (polybrominated diphenyl ethers), which have been added to consumer products (furniture, textiles and electronics).

The Ontario government is developing a strategy to further reduce toxic substances in air, land, water and consumer products. Monitoring informs such strategies and measures their effectiveness by tracking levels of toxic substances in the environment.

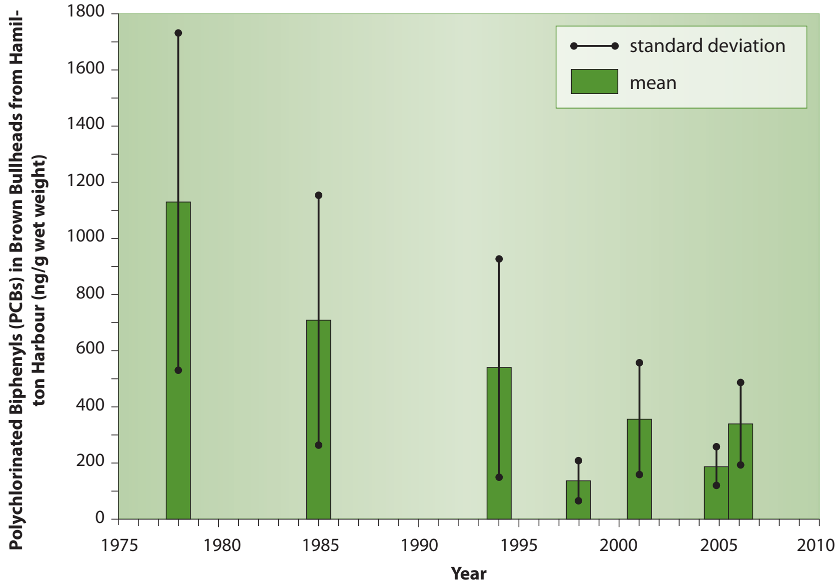
## Restoring Hamilton Harbour

Hamilton Harbour, at the western end of Lake Ontario, is contaminated with many substances including PCBs. Ministry scientists are monitoring Hamilton Harbour to track progress in cleaning up the harbour and to develop strategies for the future. Monitoring results suggest that PCB inputs to the harbour have been decreasing over time, which explains the trend of decreasing PCB concentrations in fish such as brown bullheads.

In spring 2007, ministry scientists and partners initiated a comprehensive water sampling program for

all of the major inputs to Hamilton Harbour – including streams, canals and waste water treatment plants. Results will be used to determine if there are ongoing local sources of PCBs that can be controlled and to develop strategies for continuing the restoration of the harbour.

In addition to PCBs in sediment, another sediment contamination issue in Hamilton Harbour is the elevated levels of polycyclic aromatic hydrocarbons (PAHs) in an area of the Harbour known as Randle Reef. While PCBs are a concern due to the passage of this contaminant up the food chain (bioaccumulation), the PAHs at Randle Reef are a concern due to their immediate (acute) and long-term (chronic) toxic impacts on local fish and wildlife. The contamination is the result of historical deposits of coal tar from industries that have since ceased operations. The clean up of Randle Reef has been identified as a vital component in the restoration of the harbour. The Ontario government is working with federal and municipal partners to share the costs of designing and building a containment facility around the contaminated sediment to prevent toxic substances from spreading throughout the harbour.




Concentrations of PCBs are decreasing in brown bullheads from Hamilton Harbour, suggesting that PCB inputs to the harbour are also decreasing over time. Brown bullheads are a species of catfish that live at the bottom of lakes and feed mostly on insects and plant material in the sediment.

Scientists from the ministry and partner organizations work cooperatively to collect groundwater samples from monitoring wells across Ontario.

## Fluoride in Groundwater in Southwestern Ontario

Monitoring has shown that there are elevated levels of naturally occurring fluoride in some of the monitoring wells in southwestern Ontario. Although fluoride in drinking water helps in the development of teeth and bone, high concentrations of fluoride can cause discolouration or pitting of the teeth. When groundwater quality results for a substance are found to exceed an Ontario Drinking Water Quality Standard, under the Provincial Groundwater Monitoring Network, notices are immediately sent to the local health unit, Conservation Authorities, and other local officials. An assessment is conducted to look at potential causes.

# Climate Change

The layers of a sediment core reveal the history of a lake including water and sediment quality, inputs of pollution, and what species were present at different times.

Climate change is expected to have effects on aquatic ecosystems in Ontario. However, changes in water quality that will result from a warming climate are complex, and can be difficult to understand and predict. These can include changes in types and numbers of aquatic species and changes in water temperature, chemistry and quantity. Many of the consequences of a changing climate interact with other (multiple) stressors such as acidification, urbanization and exotic species.

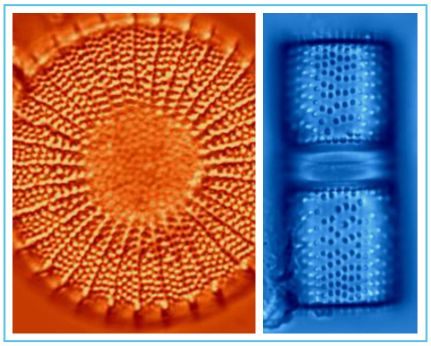
The ministry's long-term monitoring programs are helping us understand and document the effects of climate change on aquatic ecosystems throughout Ontario. This supports our ability to make realistic forecasts of the future effects of climate change on aquatic ecosystems and helps us to make plans to protect water quality.

## Climate Change Affects Lake Ecosystems

In regions where levels of acid rain and shoreline development are minimal, such as remote areas of northwestern Ontario, the impacts of climate change on lake ecosystems are more clearly evident.

"Fossils" preserved in lake sediment cores from the Lake of the Woods and the Experimental Lakes Area in northwestern Ontario record significant changes in the biology of remote lakes since pre-industrial times, with marked changes occurring over the past three decades. A wealth of information can be extracted from lake sediments. Diatoms, a diverse group of microscopic algae, are commonly found in sediment cores. The survival of individual diatom species in lakes depends on physical properties such as light and water temperature, and water quality, such as the availability of nutrients. Algae form the base of aquatic food webs. Changes to their abundance or composition as a result of climate change and other stressors may have cascading effects to higher levels of the food web.

In partnership with researchers at Queen's University, changes in the diatom community preserved in a lake sediment core from Lake of the Woods were examined. Using radiometric dating techniques, it was determined that the core was more than one hundred years old. A marked shift was observed in the composition of diatom algae in the sediment core over time. Using temperature records from Kenora airport dating back to 1899, a significant correlation was found between biological changes and changes in air temperature, providing evidence that these lakes have been affected by climate change.



Magnified images of two diatom species (photos courtesy of Kathleen Rühland, Queen's University).

# Summary

Water quality improvement strategies **have been successful,** but continued vigilance is needed to **restore and protect water quality** in Ontario.

This report presents selected findings from the Ministry's programs that are relevant to current water quality issues in Ontario including phosphorus enrichment, toxic substances, acid deposition and climate change. The monitoring results presented in this report show that water quality improvement strategies have been successful, but continued vigilance is needed to restore and protect water quality in Ontario. The Ministry's monitoring programs provide valuable information for protecting water quality now and into the future.

*Protecting our environment.*

Ontario